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Creation of training aids for human remains detection canines utilizing a non-contact, dynamic airflow volatile concentration technique

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ABSTRACT

Human remains detection (HRD) canines are trained to locate human remains in a variety of locations and situations which include minimal quantities of remains that may be buried, submerged or extremely old. The aptitude of HRD canines is affected by factors such as training, familiarity with the scent source and environmental conditions. Access to appropriate training aids is a common issue among HRD canine handlers due to overly legal restrictions, difficulty in access and storage, and the potential biological hazards stemming from the use of actual human remains as training aids. For this reason, we propose a unique approach of training aid creation, utilizing non-contact, dynamic air-flow odor concentration onto sorbent materials. Following concentration, the sorbent material retains the odor from the scent source composed of volatile organic compounds. The sorbent material containing the odor can then be utilized as a canine training aid. Training materials prepared in this manner were tested under a variety of conditions with many HRD canines to demonstrate the efficacy of the new training aids. A high level of correct canine responses to the new training aids was achieved, approaching 90%, with minimal false positives.

1. Introduction

Canines have been used as scent detectors for thousands of years [1]. The earliest detector canines were used to locate prey when hunting with their masters. Their ability to hunt and locate prey comes naturally, as all canines, domesticated and wild, have a natural drive to hunt and a keen ability to detect the particular scent given off by the prey object [2]. The use of scent canines has evolved from merely a hunting tool to a detection device used by many government and law enforcement agencies, as well as private entities. Current uses of scent canines include, but are not limited to, the detection of drugs, explosives, accelerants, humans (living and deceased), agricultural products, currency, melanoma and pests [3].

The specialty of human remains detector (HRD) canines, also known as cadaver dogs or victim recovery dogs, evolved from the search and recovery discipline. Search and rescue canines are trained to locate living humans, often in wilderness or disaster settings. While working with their search and rescue canines, handlers noticed that the canines would lose the scent path if the living person had expired, as the change from living human odor to deceased human odor was unfamiliar to these canines [4]. Based on these observations, a new class of detector dogs, HRD canines, was initiated.

Human remains detector canines are trained to locate human remains, including whole bodies, body parts, tissue, blood, bone and decomposition fluids. Several published studies focused on the capability of human remains detection canines, including the use of canines to locate extremely small or aged scent sources, such as human teeth, scattered remains, old graves, and materials that had indirect contact with remains materials. These studies show that HRD canines are adept at locating minimal quantities of odor, including buried and aged remains. However, the canines' performances can be affected by training, familiarity with the scent source, and environmental conditions [4–7].

In real life scenarios, the canine may be asked to search for a range of odors, from fresh bodies, putrefied bodies in the height of odor production, to ancient skeletal remains. The odor source may be a whole body, body parts, tissue or blood. For canines to locate all types and ages of human remains, it is imperative that handlers use an assortment of training aids when possible. Training aids commonly include human bone, gauze that has been soaked in decomposition fluid, blood, adipocere, grave dirt, and articles or clothing previously in contact with remains [6,8,9]. These training aids are difficult to obtain due to limited access imposed by legal restrictions and are potential biohazards [7].

Human tissue is considered to be a reliable scent source and can be decomposed to different levels; however, it is particularly

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difficult to obtain and has the greatest number of legal restrictions [8]. As an alternative to actual human remains, chemical pseudo scents have been used as training aids. Putrescine and cadaverine are particularly odorous compounds formed during the decomposition process and are commonly found in pseudo scent mixtures. While these compounds may be easier to obtain legally, their hazardous nature requires extra precaution during handling. Additionally, cadaverine and putrescine are not human specific as they are known to be found in all decaying organic matter [7] and have also been detected in human saliva [10]. Another drawback of pseudo scent mixtures is that there is a high likelihood that they do not represent the entire odor picture of human remains, as there have been few scientific studies showing that these particular compounds or combinations thereof are the specific odorants required by HRD canines.

A majority of HRD canine handlers in the United States and some in Europe are civilians and not directly associated with any law enforcement or government agency. Even with the many groups associated with canine human remains detection, there are no universally accepted methods for training, and there is currently no centralized organization that has established training and certification guidelines. The Scientific Working Group for Dog and Orthogonal Detector Guidelines (SWGDOG) consists of experts from local, state, federal and international agencies acting to establish best practice guidelines for detector canines, including human remains detection canines, in an attempt to improve their performance and reliability. They emphasize the need for further research in the area of human remains detection because while some research has been published on the topic, it remains minimal and inadequate. The SWGDOG subcommittee on Research and Technology has created a list of research needs for the detection canine community. In their document, SWGDOG considers the need for the development of reliable training aids to be critical, particularly for HRD canines. Improved training aids include those that are easily and legally obtainable, non-hazardous, easy to use, reusable, and representative of the whole odor picture for the canines [11].

The Scent Transfer Unit (STU-100) is a field-portable, dynamic-airflow collection device developed for the concentration of living human scent volatiles from scent samples onto a sorbent material. It consists of a small vacuum pump attached to a Teflon-coated hood designed to hold a piece of collection material. When the STU-100 is swept over the subject or object of interest, air is drawn toward the device, concentrating any volatile organic compounds (VOCs) present onto the sorbent material at the face. Following collection, the gauze pad is removed and may be presented to the canine in order to initiate a search. It is currently employed by many law enforcement and federal agencies in the United States as a method of scent collection for use with human scent canines.

Harvey and Harvey [12] demonstrated the ability of human scent detection canines to accurately trail individual humans through different environments based on the scent that was collected onto a gauze pad using the STU-100. Eight bloodhounds were run on five different trails, all between 0.5 and 1.5 miles with a "Y" shaped pattern, requiring the canine to make a decision between turning left or right. The trails were aged for 24 h prior to introduction to the canines. The trailing environments included a local park, a college campus and a downtown, urban area, all with a high amount of foot traffic making trail contamination probable. The study showed that 77.5% of all canines successfully completed the trials, demonstrating the ability of trained canines to discriminate and follow individual people based on scent collected by the STU-100.

It was further demonstrated by researchers and dog handlers at the Federal Bureau of Investigation (FBI) and the Southern California Bloodhound Coalition that the STU-100 was capable of collecting human scent from post-blast debris: A bomb was detonated and scent pads were collected from the post-blast debris using the STU-100. The scent pads were presented to twelve canine teams, which were asked to trail to the person who had handled the bomb before detonation. Of the twelve canines, 78.3% trailed to the correct person with no false positives [13].

Curran et al. [14] conducted a similar study using the STU-100 to collect human scent from post-blast debris of a roadside bomb consisting of 60 mm mortars boosted with C-4 and a peroxide bomb composed with liquid peroxide and liquid nitromethane, separately detonated. The explosive devices were handled by a human subject, detonated, and the debris was recovered. The scent evidence was collected from the debris with the STU-100, and the gauze pads were presented to canine teams. Overall, an average success from site response of 82.2% and a combined overall average success of 73.5% was reported. These studies demonstrated that trained canines can accurately trail and identify the correct subject from evidence collected with the STU-100, even under unusual or extreme situations.

As the HRD canines utilize VOCs emanating from the source of interest in the detection process, the approach employed here was to create canine training aids by the pre-concentration of VOCs emanating from human remains on a suitable sorbent. The objective of the current study is to explore the effectiveness of a non-contact, dynamic airflow sampling device that can efficiently pre-concentrate human remains VOCs onto a sorbent material from the sample matrix. To the best of our knowledge, this article represents the first research study to apply scent collection by the Scent Transfer Unit (STU-100) to the creation of canine training aids. These new generation training aids are non-hazardous, easy to obtain, and represents a comprehensive odor picture for a variety of human remains odors. Such training materials were tested with HRD canines to demonstrate the efficacy of the new training aids.

2. Materials and methods

2.1. Creation of training aids

Canine training aids were made by collecting target odors with the STU-100 onto Dukal cotton gauze (DUKAL Corporation, Syosset, NY). For VOC collection from scent sources, the STU-100 was run for 1 min, one to four inches above the sample, on the lowest flow rate setting, as had previously been determined to be the optimal setting for odor concentration prior to sampling, the sorbent material was analytically cleaned using a previously developed cleaning protocol [15]. Scent sources included freshly deceased human remains, fresh canine and chicken remains, cremated human remains (cremains) and gauze material containing decomposition fluid, adipocere, or blood. The remains of the human, canines and chicken were sampled directly. The decomposition fluid, adipocere, and blood samples were in the form of gauze pads soaked in the above mediums and placed into glass jars. The odor remaining in the jars was collected with the STU-100 by placing it directly over the opening of the jars. The jars were stored below freezing temperature when not in use. An STU blank was created by collecting air from inside a clean jar onto a clean gauze pad.

For the initial canine trials, the collection material was removed from the STU-100 and sealed into low density, 1.5-mL, polyethylene, permeable bags (Veripak, Atlanta, GA), which were then sealed into aluminized, moisture barrier bags (3 M, St. Paul, MN). For supplementary canine trials, the odor samples were either sealed directly into the aluminized bags or placed into glass jars with plastic, perforated lids (Bed, Bath and Beyond, Inc.).

2.2. Canine trials

2.2.1. General set-up

In each canine trial, a row (or rows) of ten cement blocks were placed outdoors on a paved surface approximately five feet apart. The training aids were placed inside each block and left uncovered. Each block contained a training aid, a STU blank or an untreated piece of gauze. For the training aids contained in the aluminized bags, the gauze pads were removed from the bag and placed directly into the cement block. For the training aids contained in the glass jars, the outer lid was removed, exposing a plastic, perforated lid. The canines were able to sniff the odor inside of the jar, but were not able to make direct contact with the gauze pad itself even in the case that the cement block was moved.